

Bay Area Scientists in Schools Presentation Plan

Lesson Name Can Your Eyes Fool You? The science of vision and optical illusions

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Grade Level 3/4 Standards Connection(s) PS: Light has a source and travels in a direction. Light is reflected from mirrors and other surfaces. Vision: We see objects when light traveling from an object enters our eye. LS: Structures of living things help them grow, survive and reproduce.

California Science Standards:

Light has a source and travels in a direction:

D. Students know an object is seen when light traveling from the object enters the eye

Next Generation Science Standards:

4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <p>Develop a model to describe phenomena. (4-PS4-2)</p> <p>Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)</p> <p>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <p>Construct an argument with evidence, data, and/or a model. (4-LS1-1)</p>	<p>PS4.B: Electromagnetic Radiation An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)</p> <p>LS1.A: Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)</p> <p>LS1.D: Information Processing Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal’s brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)</p>	<p>Cause and Effect Cause and effect relationships are routinely identified. (4-PS4-2)</p> <p>Systems and System Models A system can be described in terms of its components and their interactions. (4-LS1-1), (LS1-2)</p>

Common Core Standards:

ELA/Literacy:

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.

MP.4 Model with mathematics.

FOSS Connections:

Grade 4 Module: Matter and Energy
Investigation 2: Light

Teaser: Have you ever been tricked by an optical illusion, for example, at a magic show? Did you know that these tricks actually use our own brain to fool us? We will tell you about how our eyes can play tricks on us, and how our brain is responsible.

Objective:

How does the brain construct reality from our five senses? More specifically, we will be addressing visual perception, highlighting how sometimes our perception is different from reality. To do this, we'll show optical illusions and discussing the science behind how perceptual system works.

Vocabulary/Definitions: 3 – 6 important (new) words

Visual Cortex- The part of the brain that processes information taken in by your eyes

Illusion- A thing that is or is likely to be wrongly perceived or interpreted by the senses

Perspective- A way of seeing or thinking about something

Depth Perception- The ability to understand how close or far away something is

Materials:

<i>What will you bring with you?</i>	<i>What should students have ready?</i>
<ul style="list-style-type: none"> - Brain (gloves and table cloth) - Posters of various optical illusions - Flash drive with videos in PowerPoint - Activity supplies (pipe cleaners, cut out circles, ruler, paper, straws) 	<ul style="list-style-type: none"> - glue, colored pencils/markers

Classroom Set-up: *Student grouping, Power/Water, Projector, Light/Dark,*

The classroom should be set up with a projector with students facing the front. We will need students to divide into two activity groups.

Classroom Visit

1. Personal Introduction:

5 Minutes

Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?

We're students, like them, in the 17th grade. We go to UC Berkeley, where we study how the mind works. Hannah is interested in what happens when the mind doesn't work right. Katie is interested in how our mind grows.

We want to share about how the mind works, specifically how our brain works together with our five senses to construct our experiences.

Topic Introduction:

5 Minutes

What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge...

How does our visual perception work? Are there instances where our perception may be wrong? Can we use science to deconstruct things like magic tricks and optical illusions, which use our own brain to fool us? How do these tricks work?

2. Learning Experience(s):

30 Minutes

What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring... Describe in order, including instructions to kids.

Station 1: Visual Perception

Color perception

- a. Dark and light gray squares illusion
 - i. Show a poster of the color illusion, which demonstrates that that what may appear to be different colors are actually the same due to the brain's perception of light and shadow.
 - ii. We'll ask the class whether they think that the colors are the same or different and, if the latter, which one is darker.
 - iii. We will ask a volunteer to participate in a demonstration showing that the two colors are actually the same.

- b. This introduces that our visual perception may be different from reality. We will also discuss basic facts about perception in the brain (e.g., 1/3 of the brain is devoted to vision). New vocabulary: visual perception, visual cortex, rods, cones, etc.
 - c. We then will segue into other domains where our perception may be false
- Depth perception
- d. Two tables illusion
 - i. Next, we'll show a poster illustrating depth. In this poster, we'll have two tables orientated in a different ways, thus making them appear to be different sizes.
 - ii. We'll ask the class which table they think is longer and skinnier.
 - iii. We'll then ask a volunteer to participate in a demonstration that shows that the two tables are actually the same size.
 - iv. Afterwards, we'll highlight that perception again can be different from reality and that our brain uses different cues to understand relative size, such as through depth perception.
 - e. Railroad illusion
 - i. In this demonstration, we'll show two objects that are the same length and size.
 - ii. Then, we'll introduce a background image of a railroad that shows distance and depth. This causes the two objects to appear as different sizes.
 - iii. We'll discuss that our brain uses the context (such as depth) to determine relative size of objects.
 - f. Fingertip activity
 - i. Students will be asked to touch their fingers with both eyes open, and then repeat with just one eye open.
 - ii. This illustrates depth perception, specifically stereoscopic vision. We will also discuss monocular/binocular cues as a means to understand relative size of objects and their relations to others.

Station 2: Make Your Own Optical Illusion

- g. Students will break up and make their own optical illusion
 - i. Circles
 - ii. Railroad
 - iii. Pipe cleaner
 - iv. Fishbowl

3. Wrap-up: Sharing Experiences

5-10 Minutes

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

Gorilla activity

In the next task, we're going to do something slightly different. We're going to see how good students are at counting the number of times a basketball is passed. Whoever gets the correct number will get

a special opportunity. [show video] Students will write their number on a piece of paper. Afterwards we'll ask kids, for example, "who saw 6 passes?" etc. "who saw the gorilla?" We'll then discuss how the brain can focus on certain tasks but lose focus on others. Students have learned that the way that we see things happening may actually be very, very different from reality. Our brain is designed to make sense of the world, but it's not necessarily good at doing everything all at once. Instead, our brain is designed to perform optimally, but sometimes this causes us to miss things

Brain Activity

If we are able to procure a brain from our lab, we will bring it in to let the students observe and touch (while wearing gloves). The person who won the gorilla activity can be the first to touch the brain if they want.

4. Connections & Close:

3 Minutes

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

Students might also relate this to their experiences with magic tricks. But, more importantly, they're always interacting with the world and taking in visual information to understand reality. If they're interested in this topic, we can recommend they watch Brain Games, which is a family friendly show relating science to our experiences. We can also recommend certain child friendly books about the brain and perception.

Total 50 – 60 Minutes

Follow-up – After Presentation

ELA Activity:

Suggest students write a letter explaining "How we learned about vision and how we see..."

Community Resources for Science
1611 San Pablo Ave. Suite 10B
Berkeley, CA 94702

Reading Connections:

- The Brain: Our Nervous System by Seymour Simon
http://www.seymoursimon.com/index.php/books/detail/the_brain/
- Seeing (Senses and Sensors) by Alvin Silverstein <http://www.amazon.com/Seeing-Senses-Sensors-Alvin-Silverstein/dp/0761316639>
- The Complete Human Body by Dr. Alice Roberts <http://www.amazon.com/Complete-Human-Body-Book-DVD-ROM/dp/075666733X/>

Mathematics Activity:

- Have students identify symmetrical portions of the brain on a brain diagrams.

Other:

Lots of related follow-up activities can be found in the Exploratorium's Snack Book (<http://www.amazon.com/The-Exploratorium-Science-Snackbook-Jossey-Bass/dp/0470481862/>) or on the associated website: <http://www.exploratorium.edu/snacks/>

Our Optical Illusions:

Optical Illusion Activity

[http://www.mrsec.psu.edu/education/nano-activities/vision/optical illusions/make your own optical illusions.pdf](http://www.mrsec.psu.edu/education/nano-activities/vision/optical%20illusions/make%20your%20own%20optical%20illusions.pdf)

Color Image

<http://i.ytimg.com/vi/MTpvDTWurwg/maxresdefault.jpg>

Gorilla Experiment

<https://www.youtube.com/watch?v=vJG698U2Mvo>

Table Illusion

<http://mentalfloss.com/sites/default/legacy/blogs/wp-content/uploads/2011/09/table.jpg>

Railroad Illusion

http://ww2.justanswer.com/uploads/fael/2011-08-06_032529_ponzoillusionapplet.gif